REMARKS

Administrative Overview

In the Office Action mailed on November 2, 2004, claims 8 and 10 were rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 6,189,367 to Smith et al. (hereinafter "Smith"), claims 1–4, 8–10, 13, and 14 were rejected under 35 U.S.C. § 102(b) as being anticipated by U.S. Patent No. 6,370,955 to Tuller et al. (hereinafter "Tuller"), claim 9 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Smith in view of U.S. Patent No. 5,346,306 to Reading et al. (hereinafter "Reading 1"), claims 11–14 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Smith in view of U.S. Patent No. 6,336,741 to Blaine (hereinafter "Blaine"), claim 13 was rejected under 35 U.S.C. § 103(a) as being unpatentable over Smith in view of U.S. Patent No. 5,476,002 to Bowers et al. (hereinafter "Bowers"), and claims 5–7, 11, and 12 were rejected under 35 U.S.C. § 103(a) as being unpatentable over Tuller in view of U.S. Patent No. 5,474,385 to Reading (hereinafter "Reading 2"). Claims 11 and 12 were objected to as being informal because certain claim terms lacked proper antecedent basis.

The Applicants hereby amend claims 1, 7, 8, 11, and 12. Support for the amendment to independent claim 8 can be found in the specification as originally-filed at, for example, pages 2, 7, and 9. Claims 1, 7, 11, and 12 are amended to address minor wording issues and any required support therefor can be found in the specification, the drawings, and the claims as originally-filed. No new matter is introduced by these amendments. After the entry of these amendments, claims 1–14 will be pending in this application. Accordingly, the Applicants respectfully request the reconsideration of claims 1–14 in light of the amendments made above and the arguments presented below, and the withdrawal of all objections to and rejections of claims 1–14.

The Examiner's outstanding objections and rejections are addressed in the order in which they appear in the Office Action.

Each of the Claim Terms of Amended Claims 11 and 12 Exhibit a Proper Antecedent Basis

The Applicants respectfully submit that the foregoing amendments to claims 11 and 12 overcome the Examiner's objections thereto. Accordingly, the Applicants respectfully request the reconsideration of claims 11 and 12 and the withdrawal of the Examiner's objections thereto.

Amended Claims 8 and 10 are Patentable over Smith

Claims 8 and 10 are rejected under 35 U.S.C. § 102(b) as being anticipated by Smith. The Applicants respectfully traverse this rejection as applied to the claims, as amended.

A claim is anticipated only if each and every element as set forth in the claim is found, either expressly or inherently described, in a single prior art reference. See MPEP § 2131. The Applicants respectfully submit that Smith fails to meet this exacting standard as applied to Applicants' amended independent claim 8.

Applicants' invention relates, in one aspect, to a method of conducting thermogravimetric analysis. Both a flexural plate wave mass sensor and a flexural plate wave reference sensor are provided, and a sample is deposited in the flexural plate wave mass sensor. Specification at pg. 9. As recited in Applicants' amended independent claim 8, the method of conducting the thermogravimetric analysis specifically includes "heating the mass sensor and the reference sensor substantially evenly" and "determining a change in mass of the sample in response to the heating."

The Applicants respectfully submit that Smith does not teach or suggest at least these claim limitations. Smith describes a mass and heat-flow measurement apparatus that includes sample and reference microresonators, sample and reference heat-flow sensors, and sample and reference heat sinks coupled thermally to their respective heat-flow sensors. Smith at Abstract. "The apparatus may be used to measure changes in mass due to a sample on a surface of the sample microresonator and also to measure heat flows from the sample on the surface of the sample microresonator by utilizing the heat-flow sensors, which are coupled thermally to the corresponding sample or reference microresonators." Smith at Abstract. In greater detail, the sample heat-flow sensor is capable of measuring the flow of heat from the sample to the sample heat sink, and the reference heat-flow sensor is capable of measuring a reference signal relating to the flow of heat from the surface of the reference microresonator to the reference heat sink. Smith at col. 14, ln. 30–32, and at col. 14, ln. 40–43.

Accordingly, Smith simply describes measuring the flow of heat from a sample or reference microresonator to a sample or reference heat sink, respectively. The flow of heat from the sample is caused by, for example, a change in the mass of the sample resulting from external factors. Nowhere, however, does Smith teach or suggest actively "heating the mass sensor and the reference sensor substantially evenly" to cause the change in the mass of the sample, as is required to anticipate Applicants' amended independent claim 8. Furthermore, as illustrated in FIG. 5 of Smith, the sample and reference microresonators are separate and distinct from one another. There is no teaching or suggestion of a heater that commonly acts on both the sample and reference microresonators, as would be required to heat "substantially evenly" the sample and reference microresonators.

Because Smith fails to teach or suggest "heating the mass sensor and the reference sensor substantially evenly" as is required to anticipate Applicants' amended independent claim 8, Smith necessarily also fails to teach or suggest "determining a change in mass of the sample in response to the heating."

For at least these reasons, the Applicants respectfully submit that Smith fails to teach or suggest all of the elements present in the Applicants' amended independent claim 8. Therefore, the Applicants respectfully submit that amended independent claim 8, and claim 10 which depends therefrom, are patentable over Smith. Accordingly, the Applicants respectfully request that this ground of rejection be reconsidered and withdrawn.

Amended Claims 1–4 are Patentable over Tuller

Claims 1–4 are rejected under 35 U.S.C. § 102(b) as being anticipated by Tuller. The Applicants respectfully traverse this rejection as applied to the claims, as amended.

In addition to relating to a method of conducting thermogravimetric analysis, Applicants' invention, in another aspect, relates to a thermogravimetric analyzer. As recited in Applicants' amended independent claim 1, the thermogravimetric analyzer includes "a flexural plate wave mass sensor," "a flexural plate wave reference sensor," and "a heat spreader configured to conduct heat substantially evenly to the mass sensor and the reference sensor."

The Applicants respectfully submit that Tuller does not teach or suggest at least these claim limitations. Tuller describes positioning a piezoelectric balance along with a workpiece in a deposition chamber. Tuller at col. 2, ln. 9–11. "A heater 24 is also provided within the

chamber for heating the workpiece 16 and the balance 10, preferably to the same temperature." Tuller at col. 4, ln. 51–53. A reference resonator 11 is also "mounted in the chamber to provide compensation for temperature sensitivity in the balance 10." Tuller at col. 5, ln. 7–10. More specifically, "shifts in resonance or anti-resonance frequency of the balance 10 owing to shifts in temperature . . . can be effectively compensated by subtracting the change in frequency of the reference resonator 11 from the change in frequency of the balance 10 if the balance 10 and reference resonator 11 are maintained at the same temperature." Tuller at col. 5, ln. 12–18.

While Tuller describes both a sample resonator (*e.g.*, the balance 10) and a reference resonator, Tuller does not teach or suggest these resonators to be, in particular, "flexural plate wave" resonators, as is required to anticipate Applicants' amended independent claim 1. In greater detail, rather than teach or suggest specific "flexural plate wave" resonators, Tuller simply describes its resonators as including piezoelectric materials, such as langasite, that are stable at high temperatures. Tuller at col. 1, ln. 65 to col. 2, ln. 8, at col. 3, ln. 52 to col. 4, ln. 16, and at col. 5, ln. 11–12. As such, Tuller fails to teach or suggest either "a flexural plate wave mass sensor" or "a flexural plate wave reference sensor."

In addition, Tuller's heater 24 is separated from its balance 10 and reference resonator 11 only by air. See Tuller at FIG. 2. In contrast to Applicants' claimed invention, Tuller does not describe positioning a heat spreader between the heater 24 and the resonators 10, 11 to "conduct heat substantially evenly to the mass sensor and the reference sensor." While the air gap between the heater 24 and the resonators 10, 11 may convect heat in a random and unpredictable manner to the resonators 10, 11, it will not "conduct heat substantially evenly to the mass sensor and the reference sensor." As such, Tuller also fails to teach or suggest "a heat spreader configured to conduct heat substantially evenly to the mass sensor and the reference sensor."

For at least these reasons, the Applicants respectfully submit that Tuller fails to teach or suggest all of the elements present in the Applicants' amended independent claim 1. Therefore, the Applicants respectfully submit that amended independent claim 1, and claims 2–4 which depend therefrom, are patentable over Tuller. Accordingly, the Applicants respectfully request that this ground of rejection be reconsidered and withdrawn.

Amended Claims 8–10, 13, and 14 are Patentable over Tuller

Claims 8–10, 13, and 14 are rejected under 35 U.S.C. § 102(b) as being anticipated by Tuller. The Applicants respectfully traverse this rejection as applied to the claims, as amended.

Like Applicants' amended independent claim 1, amended independent claim 8 recites "providing a flexural plate wave mass sensor" and "providing a flexural plate wave reference sensor." For at least the reasons described above, Tuller fails to teach or suggest providing either "a flexural plate wave mass sensor" or "a flexural plate wave reference sensor," and therefore also fails to teach or suggest all of the elements present in Applicants' amended independent claim 8. As such, the Applicants respectfully submit that amended independent claim 8, and claims 9, 10, 13, and 14 which depend therefrom, are patentable over Tuller. Accordingly, the Applicants respectfully request that this ground of rejection be reconsidered and withdrawn.

Amended Claim 9 is Patentable over Smith in view of Reading 1

Claim 9 is rejected under 35 U.S.C. § 103(a) as unpatentable over Smith in view of Reading 1. The Applicants respectfully traverse this rejection as applied to the claim, as amended.

To establish a prima facie case of obviousness, three basic criteria must be met. First, there must be some suggestion or motivation, either in the references themselves or in the knowledge generally available to one of ordinary skill in the art, to modify the references or to combine reference teachings. Second, there must be a reasonable expectation of success. Finally, the prior art reference (or references when combined) must teach or suggest all the claim limitations. Moreover, the teaching or suggestion to make the claimed combination and the reasonable expectation of success must both be found in the prior art and not be based on Applicants' disclosure. See MPEP § 706.02 (j) and § 2143. In addition, if a proposed modification would render the prior art invention being modified unsatisfactory for its intended purpose, then there is no suggestion or motivation to make the proposed modification. See MPEP § 2143.01.

Reading 1 describes a thermal analysis technique known as Differential Scanning Calorimetry (DSC). According to the technique, a sample material is heated along a linear temperature ramp that is modulated with a sinusoidal heating rate oscillation. The resultant heat-flow signal is then deconvoluted into rapidly reversible and non-rapidly reversible components.

Reading 1 at Abstract. The differential scanning calorimeter includes a sample pan, a reference pan, a thermoelectric disk, and an electric furnace. Reading 1 at col. 7, ln. 15–20. "The thermoelectric disc 116 serves as the major heat-flow path for transferring heat from furnace 119 to sample pan 112 and reference pan 113." Reading 1 at col. 7, ln. 29–32. Accordingly, Reading 1 describes heating the sample and reference pans.

As explained above, Smith does not teach or suggest heating its sample or reference microresonators. In fact, in stark contrast to what is described in Reading 1, Smith states that "[a] key requirement in the microresonator and heat-flow sensor combination device is to provide a path of high thermal conductivity from the piezoelectric crystal surface to the heat-flow sensor. Otherwise, at high heat-flow rates, the central portion of the piezoelectric crystal surface may heat up, thus producing temperature gradients within the crystal and accompanying shifts in resonant frequency." Smith at col. 12, ln. 7–13.

Combining the teachings of Reading 1 with the teachings of Smith would necessarily lead to Smith's microresonators being heated as described in Reading 1. This would, as a consequence, also lead to the very shift in the resonant frequencies of Smith's microresonators that Smith cautions against, thereby rendering the microresonators unsatisfactory for their intended purpose. Accordingly, there is no suggestion or motivation to combine Smith's teachings with Reading 1's teachings.

For at least this reason, the Applicants respectfully submit that dependent claim 9 is patentable over Smith in view of Reading 1. Accordingly, the Applicants respectfully request that this ground of rejection be reconsidered and withdrawn.

Amended Claims 11–14 are Patentable over Smith in view of Blaine

Claims 11–14 are rejected under 35 U.S.C. § 103(a) as unpatentable over Smith in view of Blaine. The Applicants respectfully traverse this rejection as applied to the claims, as amended.

With respect to Applicants' amended independent claim 8, Smith fails to teach or suggest, as explained above, "heating the mass sensor and the reference sensor substantially evenly." In addition, Smith also fails to teach or suggest, as also explained above, "determining a change in mass of the sample in response to the heating." The Applicants respectfully submit that Blaine fails to cure these deficiencies of Smith.

Blaine describes "methods for controlling the temperature program used with thermogravimetric analyses." Blaine at col. 1, ln. 14–16. More specifically, Blaine teaches that "[t]he sample is surrounded by a furnace, or oven, composed of elements 7–10" (emphasis added) and that "[t]he temperature of the furnace is controlled by a heater controller 12." Blaine at col. 4, ln. 7–9. Blaine does not also teach or suggest, however, heating a reference sensor, much less "heating the mass sensor and the reference sensor substantially evenly" as required by Applicants' amended independent claim 8. As a result, Blaine necessarily also fails to teach or suggest "determining a change in mass of the sample in response to the heating," as also required by Applicants' amended independent claim 8.

For at least these reasons, the Applicants respectfully submit that Blaine fails to cure Smith's deficiencies with respect to Applicants' amended independent claim 8. Therefore, the Applicants respectfully submit that amended independent claim 8, and claims 11–14 which depend therefrom, are patentable over Smith in view of Blaine. Accordingly, the Applicants respectfully request that this ground of rejection be reconsidered and withdrawn.

Amended Claim 13 is Patentable over Smith in view of Bowers

Claim 13 is rejected under 35 U.S.C. § 103(a) as unpatentable over Smith in view of Bowers. The Applicants respectfully traverse this rejection as applied to the claims, as amended.

As explained above, Smith fails to teach or suggest, with respect to Applicants' amended independent claim 8, "determining a change in mass of the sample in response to the heating." For the reasons that follow, the Applicants respectfully submit that Bowers fails to cure this deficiency of Smith.

Bowers describes "a contamination monitor which is capable of measuring contamination at the molecular level." Bowers at col. 1, ln. 14–16. Bowers' described monitor employs a first sensing resonator and a second reference resonator. The sensing resonator is exposed to the environment to measure the non-volatile residue (NVR) contamination that is deposited on its surface, while the reference resonator is hermetically sealed in a standard electronics package to prevent any contamination from effecting its resonant frequency. Bowers at col. 5, ln. 66 to col. 6, ln. 9. To measure the NVR contamination that is deposited on the sensing resonator's surface, "[a]n output signal from the sensing resonator 22 is mixed with an output signal from the reference resonator 24 . . . and the difference or beat frequency [representing the amount of NVR

contamination deposited on the sensing resonator's surface] is determined." Bowers at col. 6, ln. 16–20.

"In order to guard against false NVR readings due to drastic changes in the environment temperature, the temperature of the SAW resonators 22, 24 is actively controlled apart from the temperature fluctuations in the surrounding environment. By actively controlling the temperature of the SAW resonators 22, 24 to maintain a preset or preselected temperature, temperature changes in the environment will not induce a major drift in the baseline temperature." Bowers at col. 7, ln. 20–27. "The temperature control system 32 is able to directly heat and cool the SAW resonators 22, 24 to maintain the resonators at a preset temperature independent of the environmental conditions." Bowers at col. 7, ln. 36–39.

In other words, Bowers describes heating the sensing and reference resonators when the environmental temperature decreases, and cooling the sensing and reference resonators when the environmental temperature increases. In such a fashion, the sensing and reference resonators are maintained at a near constant preset or preselected temperature. Accordingly, because the temperature of the sensing and reference resonators is kept constant, any change in the difference or beat frequency of the resonators is due to the amount of NVR contamination (*i.e.*, the mass of NVR contamination) deposited on the sensing resonator's surface, and not due to the change in the environmental temperature.

Thus, unlike in a thermogravimetric method or system such as the Applicants', where the sample is heated to cause a detectable change in its mass, Bowers describes detecting a change in a sample's mass with the sample temperature held constant. In essence, Bowers does not describe a thermogravimetric analysis method or system at all, but rather a method and system for detecting a simple accumulation of NVR contamination on the sensing resonator's surface. Accordingly, like Smith, Bowers does not teach or suggest "determining a change in mass of the sample in response to the heating," as recited by Applicants' amended independent claim 8.

For at least this reason, the Applicants respectfully submit that Bowers fails to cure Smith's deficiency with respect to Applicants' amended independent claim 8. Therefore, the Applicants respectfully submit that amended independent claim 8, and claim 13 which depends therefrom, are patentable over Smith in view of Blaine. Accordingly, the Applicants respectfully request that this ground of rejection be reconsidered and withdrawn.

Amended Claims 5–7, 11, and 12 are Patentable over Tuller in view of Reading 2

Claims 5–7, 11, and 12 are rejected under 35 U.S.C. § 103(a) as unpatentable over Tuller in view of Reading 2. The Applicants respectfully traverse this rejection as applied to the claims, as amended.

As explained above, Tuller fails to teach or suggest, with respect to Applicants' amended independent claims 1 and 8, either "a flexural plate wave mass sensor" or "a flexural plate wave reference sensor." The Applicants respectfully submit that Reading 2 fails to cure this deficiency of Tuller.

Reading 2 describes a thermal analysis technique known as Dynamic Differential Scanning Calorimetry (DDSC). According to the technique, a sample material is heated with a rapid heating rate oscillation added to a conventional linear temperature ramp. Reading 2 at col. 1, ln. 37–38. "The heat-flow to and from the sample is recorded, and then deconvoluted into rapidly reversible and non-rapidly reversible components." Reading 2 at col. 1, ln. 42–44. The DDSC apparatus includes a sample pan, a reference pan, a thermoelectric disk, and an electric furnace. Reading 2 at col. 1, ln. 45–55. "The thermoelectric disc 116 serves as the major heat-flow path for transferring heat from furnace 119 to sample pan 112 and reference pan 113." Reading 2 at col. 1, ln. 59–61.

While Reading 2 describes both a sample pan and a reference pan, Reading 2 does not teach or suggest these pans to be, in particular, "flexural plate wave" sensors, as recited in both of Applicants' amended independent claims 1 and 8. In greater detail, rather than teach or suggest specific "flexural plate wave" sensors that initiate Lamb waves at a given frequency at one end of a propagation medium and that detect the Lamb waves at the other end of the propagation medium at a detected frequency, see Specification at pg. 5, Reading 2 only describes simple pans. As such, Reading 2 fails to teach or suggest either "a flexural plate wave mass sensor" or "a flexural plate wave reference sensor."

For at least this reason, the Applicants respectfully submit that Reading 2 fails to cure Tuller's deficiencies with respect to Applicants' amended independent claims 1 and 8. Therefore, the Applicants respectfully submit that amended independent claim 1, and claims 5–7 which depend therefrom, and amended independent claim 8, and claims 11 and 12 which depend

therefrom, are patentable over Tuller in view of Reading 2. Accordingly, the Applicants respectfully request that these grounds of rejection be reconsidered and withdrawn.

CONCLUSION

In light of the foregoing, the Applicants respectfully submit that all of the pending claims are in condition for allowance. Accordingly, the Applicants respectfully request reconsideration, withdrawal of all grounds of objection and rejection, and allowance of all of the pending claims in due course.

If the Examiner believes that a telephone conversation with the Applicants' attorney would be helpful in expediting the allowance of this application, the Examiner is invited to call the undersigned at the number identified below.

Respectfully submitted,

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